NAME: CLASS PERIOD: DATE:

Investigation

SPLITTING ATOMS

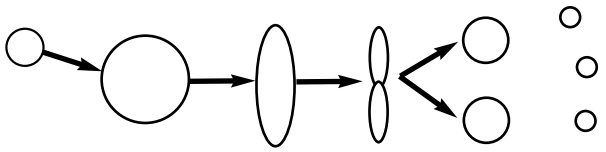
Background

Nuclear fission occurs when an atom's nucleus is split apart. When this is done, a tremendous amount of energy is released as high-energy neutrons and light. If fission occurs quickly, there is an explosion, as in an atomic bomb. If it occurs slowly, the energy can be harnessed to generate electricity.

Several isotopes undergo fission if bombarded by neutrons with enough energy. However, uranium 235 is the fuel most commonly used, because U-235 can be split into fragments using low-energy neutrons. The fission of U-235 is complicated, because several different types of isotopes may be produced as a result.

During nuclear fission more energy is produced than consumed. This exothermic reaction then becomes self-sustaining, i.e., a chain reaction. When a neutron is absorbed by nuclear fuel, the nucleus deforms and splits. The products are neutrons and two unequal fragments called "daughter material." Neutrons released by the splitting of the atom strike other atoms, splitting them in turn, and so on. The daughter material contains too many neutrons and quickly begins to decay. The radioactive daughter material is the source of nuclear waste.

Just before the atom splits it changes shape. Imagine the atom's beginning shape as round. Just before it splits, it elongates into an oval shape that then appears to be pinched in the middle (like a bow tie).



neutron bombards nuclear fuel

products consist of radioactive daughter material and neutrons

Drops of liquid can also take on the same deformation before fragmenting into smaller droplets. In this demonstration you will observe this behavior occurring in oil.

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Materials

250 ml beaker
125 ml rubbing alcohol (isopropyl alcohol)
50 ml water
1-2 ml of cooking oil
teaspoon
small dropper or pipette

Procedure

1. Pour 125 ml of rubbing alcohol into the beaker.
2. Add 50 ml of water to the alcohol in the beaker and stir.
3. Fill the dropper or pipette with 1-2 ml of cooking oil.
4. Insert the dropper or pipette halfway down into the beaker of alcohol and water.
5. Slowly release the oil into the alcohol-and-water mixture.
6. The oil should stay suspended in the mixture. If it rises instead, carefully add a little more alcohol away from the oil drop. If the oil sinks, carefully add a little more water away from the oil drop.
7. With the teaspoon, carefully push down on the middle of the suspended oil drop and observe the different shapes the oil drop takes on before it splits into two or more drops.

Observations

1. What shape did the oil drop have before you applied pressure?

2. How did the shape of the oil drop change as you applied pressure?

SPLITTING ATOMS
INVESTIGATION CONT.

Application

1. Complete the table for a chain reaction where two neutrons from each reaction cause a new reaction.

Reaction Number	1	2	3	4	5	6	7
No. of Reactions	1	2	4				

2. Complete the table for a chain reaction where three neutrons from each reaction cause a new reaction.

Reaction Number	1	2	3	4	5	6	7
No. of Reactions	1						

3. Complete the table for a chain reaction where four neutrons from each reaction cause a new reaction.

Reaction Number	1	2	3	4	5	6	7
No. of Reactions	1						

Going further

1. The key to an efficient nuclear reactor is a fuel that releases the largest possible number of neutrons for each neutron absorbed. An atom of uranium 235 has 92 protons and 143 neutrons. When it splits, will the same number of neutrons always be released? How might this affect the efficiency of the reactor?

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